The Evolution of Utilizing Manual Throttles to Avoid Low LH_2 NPSP at the SSME Inlet

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Even before the first flight of the Space Shuttle, it was understood low liquid hydrogen (LH_2) Net Positive Suction Pressure (NPSP) at the inlet to the Space Shuttle Main Engine (SSME) can have adverse effects on engine operation. A number of failures within both the External Tank (ET) and the Orbiter Main Propulsion System could result in a low LH_2 NPSP condition. Operational workarounds were developed to take advantage of the onboard crew's ability to manually throttle down the SSMEs, which alleviated the low LH_2 NPSP condition. A throttling down of the SSME resulted in an increase in NPSP, mainly due to the reduction in frictional flow losses while at a lower throttle setting. As engineers refined their understanding of the NPSP requirements for the SSME (through a robust testing program), the operational techniques evolved to take advantage of these additional capabilities. Currently the procedure, which for early Space Shuttle missions required a Return-to-Launch-Site abort, now would result in a nominal Main Engine Cut Off (MECO) and no loss of mission objectives.